

The term “depreciation rate” is often used as shorthand for two related, but distinct concepts in productivity analysis. The first concept, depreciation, is equal to the difference in value of two assets of different vintage at a given point in time. Depreciation is one component of the price of capital. The second concept, replacement, represents the decline in efficiency of an asset as it ages. Replacement is a central concept in the measurement of capital quantity. Academic research has shown that one can generally use the same geometric rate to represent both depreciation and replacement, hence the term depreciation rate is often used for both concepts. While both concepts are used in measuring TFP, the concept of replacement is of primary importance, since it is a key element in measuring the quantity of capital.

The age-efficiency trends of assets are independent of regulatory costing rules. Consequently, the correct replacement rate in a TFP study should be determined independently of the process whereby benchmark access rates are set. Furthermore, the determination of the appropriate replacement rates is a complicated technical issue requiring extensive research.

- 5. The ILEC cost of capital is likely to be higher under competition than under regulation. This higher cost of capital will increase the price of capital, but will have a negligible impact on measured TFP.**

Under competition, the ILECs will have a more volatile income stream, which will result in a higher cost of capital. This increase in the cost of capital will lead to an increase in the price of capital input (though it might increase, decrease, or leave unchanged the growth rate of the price of capital input). This increase in the price of capital input will lead to a small increase in the capital cost share. Since the quantity of capital input has grown at a more rapid rate than other inputs, its larger cost share will lead to an increase in the rate of Total Input growth, and a decrease in TFP growth, though the magnitude of the impact on TFP growth would in all likelihood be minimal.

IV. Conclusion

For the most recent five-year period, 1990-1995, the results of the TFP Review Plan model show that TFP for the LECs under price cap regulation grew at an average annual rate of 3.1%. Over this same period, average annual TFP growth for the U.S. economy was 0.4%, resulting in a 2.7% TFP differential as the basis for the X-Factor in the LEC price cap formula.

In response to the FCC's December 24, 1996 Notice, we believe there is no basis for increasing the X-Factor as competition in LEC markets intensifies. In fact, the evidence indicates that the X-Factor should be reduced. For example, restructuring of CCLC and the TIC will reduce measured TFP growth

by approximately 0.4% per year. Other or different restructuring could produce larger reductions. Loss of demand growth to competitors could reduce measured TFP growth by 0.6% to 2.0% per year.

Economic depreciation is the appropriate concept for measuring TFP, and we have consistently used economic depreciation rates in our measurement of TFP. Finally, the use of a forward-looking cost of capital (which is likely to be higher than the LECs cost of capital under regulation) would have a minimal effect on measured LEC TFP.

ATTACHMENT 6

“CRITIQUE OF THE AT&T PERFORMANCE- BASED MODEL”

Christensen Associates

**USTA COMMENTS
CC Docket No. 96-262
January 29, 1997**

EXECUTIVE SUMMARY

Critique of the AT&T Performance-Based Model Christensen Associates January 29, 1997

In their December 24, 1996 Notice in the Access Reform proceeding, the FCC inquired whether there is any justification for increasing the productivity offset in the LEC price cap plan. In the FCC's Price Cap proceeding, AT&T has, in fact, argued that the LEC productivity offset should be increased. They base their claim on the results of the AT&T Performance-Based Model. As we demonstrate in this paper, AT&T's Performance-Based Model, developed by Dr. John R. Norsworthy, contains numerous methodological and computational errors that lead to invalid results. Therefore, AT&T's claim that the LEC productivity offset should be increased is without merit.

Among the errors, two fundamental errors stand out: Norsworthy's erroneous assumption that Total Cost must equal Total Revenue in every period and his unsupportable claim to be able to meaningfully estimate interstate-only productivity.

The AT&T-sponsored model bases its estimate of Total Cost on the erroneous assumption that Total Cost must equal Total Revenue in each annual observation. We demonstrate that when the X factor is based on historical productivity and input price growth, as it is in the AT&T-sponsored model, this assumption would result in the X factor being based on historical output price growth, entirely independent of actual changes in LEC productivity or input prices. Thus, the AT&T-sponsored model would result in a self-perpetuating price cap X factor that would, inherent in its design,

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misrepresent actual achieved productivity gains. Alone, this conceptual flaw in the AT&T-sponsored model would subvert the intent of the FCC to adopt an economically-meaningful productivity measure that would provide the maximum flow of efficiency improvements to ratepayers.

The other fundamental error is Norsworthy's economically arbitrary computation of interstate-only productivity. As we have demonstrated before, one cannot calculate an economically meaningful measure of interstate-only productivity because of the joint and common inputs used by telephone companies to produce both interstate and intrastate services. Moreover, this meaningless computation leads to an significant overstatement of LEC productivity growth because the AT&T model takes the highest growing output sub-category—interstate services—and inappropriately relates it to total input growth.

There are a number of other errors in Dr. Norsworthy's AT&T Performance-Based Model that cause the model to substantially overstate LEC productivity growth. Among the other errors in the AT&T model that are documented in our analysis are:

- Local and Toll output are incorrectly measured with simple physical measures;
- Interstate Access output is incorrectly measured because of a fundamental confusion of end-user services with carrier access services;
- Costs are incorrectly assigned to Labor, Materials, and Capital;
- The constructed Materials price index does not accurately measure LEC purchases;
- The Capital quantity index is not fully documented and appears to have errors;
- Numerous data extrapolations are used that rely on arbitrary (and, sometimes, undocumented) bases, and are unnecessary in some instances.

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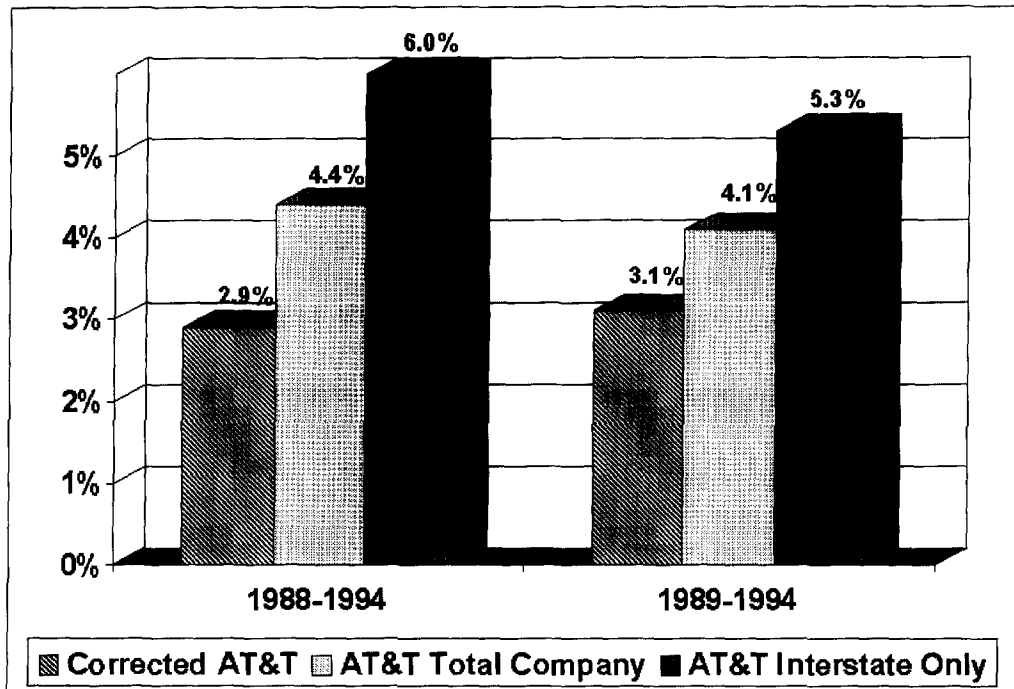
In addition the AT&T model is missing documentation, and has incorrect documentation. Thus, Dr. Norsworthy's claims that the AT&T Performance-Based Model is accurate, valid, fully documented, and reproducible are false. The AT&T model fails to meet the FCC standards that require models to be fully documented, reproducible and produce valid results.

The significant errors in the AT&T-sponsored model result in incorrect measures of both productivity and input price growth, preventing the use of the AT&T evidence in drawing any valid conclusions regarding productivity growth, input price growth, or the appropriate value for the LEC X factor. As we demonstrate, once the AT&T results are corrected for methodological and computational errors, and GTE, Southern New England, Sprint and Aliant are added to the analysis, the results become virtually identical to the results of the Total Factor Productivity Review Plan (TFPRP) model calculated by Christensen Associates and sponsored by USTA. A summary of the impact of AT&T's errors on measured productivity growth can be found in Exhibit 1, which compares the corrected AT&T results with Dr. Norsworthy's AT&T "Total Company" and AT&T "Interstate-Only" results.

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Exhibit 1

AT&T's Model Overstates LEC Productivity Growth



In summary, our analysis demonstrates that once the errors in the AT&T-sponsored model are corrected, the AT&T-sponsored results validate the USTA/Christensen results.

Critique of the AT&T Performance-Based Model
Christensen Associates
January 29, 1997

Introduction

In their December 29, 1996 Notice in the Access Reform proceeding, the FCC inquires whether there is any justification for increasing the productivity offset in the LEC price cap plan.¹ In the FCC's Price Cap proceeding, AT&T has, in fact, argued that the LEC productivity offset should be increased.² They base their claim on the results of the AT&T "Performance-Based" Model. The "Performance-Based" Model is a spreadsheet analysis of Local Exchange Carrier (LEC) revenue and expense, developed by Dr. John R. Norsworthy.³ This spreadsheet analysis was originally made available to interested parties on January 29, 1996, and a revised version of the spreadsheet analysis was made available to interested parties on July 10, 1996. Both the original and revised versions of the model contain numerous errors, which we identify in this report. These errors lead to invalid results. Therefore, AT&T's claim that the LEC productivity factor should be increased is without merit.

¹ Federal Communications Commission, Notice of Proposed Rulemaking, Third Report and Order, and Notice of Inquiry, CC Dockets 96-262, 94-1, 91-213, and 96-263, December 24, 1996, para 233.

² Comments of AT&T on Fourth Further Notice of Proposed Rulemaking, CC Docket 94-1, January 11, 1996; Reply Comments of AT&T on Fourth Further Notice of Proposed Rulemaking, CC Docket 94-1, March 11, 1996.

³ Statement of Dr. John R. Norsworthy, filed as Appendix A to Comments of AT&T on Fourth Further Notice of Proposed Rulemaking, CC Docket 94-1, January 16, 1996. Hereafter referred to as the "Norsworthy Report."

We find that the model suffers from a number of methodological and computational errors. The AT&T-sponsored methodology includes both historical productivity and input price differentials in the X factor. A few of the errors in the AT&T-sponsored model affect input price and productivity in offsetting ways, leaving AT&T's X factor unaffected. Most of AT&T's errors, however, incorrectly overstate AT&T's measured X factor.

Errors that overstate AT&T's X factor include: the erroneous assumption that TFP can be meaningfully measured for interstate services only; the assumption that revenues must equal cost in every period; inaccurate measures of Local, Toll and Interstate Access output; and the omission of Miscellaneous Services from the measurement of Total Output.

Errors that have effects on both AT&T's measurement of productivity and input price growth include: incorrect assignment of costs to Labor, Materials, and Capital; the inappropriate use of input/output tables to construct the Materials price index; and the computation of Capital and Labor input quantities. Although the errors in productivity measurement are offset by corresponding errors in the measurement of input prices, leaving AT&T's defined X factor unchanged, it still remains the case that these errors cause the AT&T model to produce unreliable results. This prevents the use of the AT&T evidence in drawing any valid conclusions regarding either TFP or input price growth.

In addition, we find that the AT&T-sponsored spreadsheet analysis is not fully documented, is often incorrectly documented, is based on incomplete data, and is

partially based on arbitrarily extrapolated estimates rather than actual data. These deficiencies belie Dr. Norsworthy's claim that his methodology is fully documented and reproducible.⁴

Finally, the AT&T-sponsored model only provides estimates for the seven Regional Bell Operating Companies (RBOCs). This is in contrast to the Total Factor Productivity Review Plan (TFPRP) model calculated by Christensen Associates and sponsored by USTA, which includes the RBOCs, GTE, Southern New England, Sprint and Aliant (formerly Lincoln). Therefore, the AT&T model does not comprehensively measure performance of the LECs subject to price cap regulation.

As we demonstrate, once the AT&T results are corrected for methodological and computational errors, and GTE, Southern New England, Sprint and Aliant are added to the analysis, the AT&T-sponsored productivity and input price growth estimates support our USTA TFPRP results because the results are virtually identical.

The AT&T Analysis is Based on the Erroneous Assumption that One Can Measure TFP for Interstate Services

As we demonstrated in USTA's Reply Comments,⁵ one cannot calculate an economically meaningful measure of interstate TFP; yet the AT&T analysis continues to be based on this fallacy. Interstate services and intrastate services have joint and

⁴ Norsworthy Report, pp. 69-70.

⁵ "Total Factor Productivity Methods for Local Exchange Carrier Price Cap Plans: Reply Comments," Christensen Associates, March 1, 1996. Filed as Attachment A to Reply Comments of the United States Telephone Association on Fourth Further Notice of Proposed Rulemaking, CC Docket No. 94-1, March 1, 1996. Hereafter referred to as "Christensen Reply"

common inputs; consequently one cannot define or isolate interstate inputs in an economically meaningful manner.

The AT&T model arbitrarily assumes that interstate input growth equals Total Input growth. Our analysis in USTA's Reply Comments demonstrated that this specific assumption yields arbitrary and capricious results.⁶ There, we provided an example of a paper clip manufacturer that produces red and blue paper clips where the sales of red paper clips was greater than the sales of blue paper clips. Except for the pigment applied to the paper clip, the production process was exactly the same for red and blue paper clips—i.e., joint and common inputs were used. We demonstrated that the arbitrary assumption that their inputs grew at the same rate led to the economically meaningless conclusion that the “productivity” growth of one color of paper clip was different from the “productivity” growth of the other color of paper clip. Because AT&T's interstate productivity calculations are based on the same arbitrary assumption, the AT&T-sponsored interstate productivity results must be rejected in their entirety.

As demonstrated in Table 1 below, the erroneous AT&T assumption that one can separately measure total factor productivity for interstate services results in a significant overstatement in AT&T's measurement of LEC productivity growth. The overstatement arises because AT&T has taken the highest growing LEC output sub-category—interstate services—and inappropriately related interstate output growth to total input growth. However, with joint and common inputs, there is no economically meaningful measure of input growth for only interstate services. The AT&T

⁶ Christensen Reply, pp. 4-7.

overstatement of LEC productivity growth due to this erroneous assumption averages 1.6 percentage points per year over the 1988-1994 period, and 1.2 percentage points per year over the most recent five-year period, 1989-1994.

The AT&T Model is Based on the Erroneous Assumption that the Cost of Total Input Must Equal Total Revenue

The AT&T model bases its estimate of Total Cost on an assumption that Total Cost must equal Total Revenue in each annual observation for the regulated LEC industry. This flawed calculation is apparently based on Dr. Norsworthy's erroneous assertion that this is required by the economic theory of production.

As we discussed in the Christensen Reply, economic theory holds that Total Cost does not necessarily equal Total Revenue, particularly for regulated firms or for firms with increasing returns to density.⁷ Typically, productivity studies that focus on regulated industries recognize that Total Cost does not necessarily equal Total Revenue. These studies generally construct estimates of Total Cost that are independent of Total Revenue.⁸ Unlike the AT&T model, the USTA TFPRP model follows this accepted practice of calculating Total Cost independently of Total Revenue.

Dr. Norsworthy's erroneous assumption that Total Cost must equal Total Revenue in each period is really an assumption that LEC's earn their opportunity cost

⁷ Christensen Reply, pp. 16-17.

⁸ Two examples of published research based on this approach is D.W. Caves, L.R. Christensen, and J.A. Swanson, "Productivity in U.S. Railroads, 1951-1974, Bell Journal of Economics, Spring 1980, pp. 166-181, and E.R. Berndt, A.F. Friedlaender, J.S. Wang Chiang, and C.A. Velluro, "Cost Effects of Mergers and Deregulation in the U.S. Rail Industry, Journal of Productivity Analysis, 1993, pp. 127-144.

of capital in every period, which is not true in general. Equating Total Cost to Total Revenue implies that the realized rate of return on capital is always equal to the economic cost of capital, which is given by capital's opportunity cost. However, real-world outcomes are such that the LEC's realized rates of return may be above (economic profit) or below (economic loss) their opportunity cost of capital in any period. Dr. Norsworthy essentially assumes that the LEC's find themselves in a perfectly competitive equilibrium where realized returns are always equal to capital's opportunity cost. Clearly, however, the LECs are in a transition from a monopoly to a competitive position in the markets they serve. Therefore, the assumption that Total Cost equal Total Revenue does not represent the true opportunity cost of capital faced by the LECs. In fact, as noted by Dr. Frank M. Gollop, if it were the case that the LEC's realized rates of return were always equal to their opportunity cost of capital, there would be no need to regulate the LECs.⁹

By basing its estimate of Total Cost on Total Revenue, the AT&T model suffers from an additional shortcoming; it can never be used to accurately update the X factor under price cap regulation—as it is attempting to do in this instance. The AT&T model bases the X factor on estimates of Input Price Growth and productivity growth, and it uses Total Revenue to estimate Total Cost. This is equivalent to basing the X factor on historical trends in output price growth.¹⁰ When the X factor is based on historical

⁹ Frank M. Gollop, "An Economic Analysis of the AT&T and Ad Hoc Comments," Statement in Support of BellSouth Reply Comments on Fourth Further Notice of Proposed Rulemaking, CC Docket 94-1, March 1, 1996, pp. 23-29.

¹⁰ See Appendix 1 for a mathematical demonstration of this result.

trends in output price growth, it becomes self-perpetuating. For example, suppose that the historical output price trends lead to an initial X factor of 3. Then, the "Performance-Based" approach suggested by AT&T, if calculated without errors, would result in a Price Cap Index that will decrease relative to the GDPPI at the rate of 3% per year. This implies that the Actual Price Index would decrease at least 3% per year, relative to the GDPPI. When the X factor is recalibrated, the AT&T approach would effectively base the updated X factor on the recent trends in the Actual Price Index.

Recalibration of the X factor using the AT&T-sponsored model would be entirely independent of actual changes in productivity or input price. Once AT&T incorrectly defines Total Costs by Total Revenues, the X factor does not depend on TFP growth or input price growth. This is a fundamental flaw in the AT&T-sponsored model. Actual changes in productivity or input price merely translate into changes in AT&T's residually-determined price of capital and have no impact on AT&T's measured X.

The result of AT&T's erroneous assumption that Total Cost must equal Total Revenue in every period is that, over the 1988-1994 period, AT&T's measurement of productivity growth is overstated by an average of 0.4 percentage points, and input price growth is understated by an average of 1.3 percentage points, overstating AT&T's calculated X factor by an average of 1.7 percentage points. For the most recent five-year period, 1989-1994, this erroneous assumption results in an overstatement in productivity growth averaging 0.4 percentage points, and an understatement of input price growth averaging 1.8 percentage points, thus, overstating AT&T's estimate of X by an average of 2.2 percentage points.

The AT&T Model Fails to Construct a Comprehensive Measure of Total Output, Resulting in a Meaningless, Upwardly-Biased Estimate of Total “Regulated Services” Productivity

The AT&T model contains an economically meaningless productivity estimate for “regulated services” because the AT&T model fails to construct a comprehensive index of Total Output. The AT&T model attempts to construct a quantity index of Local, Toll, and Interstate Access services. This index excludes the Miscellaneous Services output category. Since Miscellaneous Services are provided by the same inputs that are used to provide Local, Toll, and Access services, it is incorrect to exclude those Miscellaneous Services from Total Output. The TFPRP results show that Miscellaneous Services output has grown at a slower rate than the rest of Total Output.¹¹ Therefore, exclusion of Miscellaneous Services leads to an overestimate of Total Output growth and an overestimate of productivity growth that averages 0.4 percentage points over the 1988-1994 period, and 0.5 percentage points per year over the most recent five-year period, 1989-1994.

The AT&T Model is Based on Inaccurate Measures of Local, LEC Toll, and Interstate Access Output

Local and Toll Output. The AT&T model uses two physical measures of output to represent Local and LEC Toll output: the number of local calls (found in the AT&T

¹¹ See Comments of the United States Telephone Association on Fourth Further Notice of Proposed Rulemaking, CC Docket 94-1, January 16, 1996, Attachment B. Page 1 of OUTIDX3 shows that Miscellaneous output growth (line 260) averaged -1.2% over the 1988-1994 period, while Total output growth (line 300) averaged 3.5% over the 1988-1994 period.

spreadsheet TFPLEC.WK4, cells R23-R33¹²) and the number of toll minutes of use (AT&T spreadsheet TFPLEC.WK4, S23-S33). It should be noted that Dr. Norsworthy has been inconsistent in describing the measure of LEC Toll output in the AT&T-sponsored model. In his original filing, Dr. Norsworthy refers to the Toll output measure as "minutes of intrastate toll calls."¹³ However, in the TFPLEC spreadsheet, the Toll output measure is described as "number of intra toll calls." Thus, it is unclear from the documentation provided whether LEC Toll output in the AT&T sponsored model is based on minutes or number of calls. In either case (whether AT&T's documentation was incorrect then, or incorrect now), its approach to measuring output remains incorrect.

As we discussed in the Christensen Reply, the heterogeneity of telephone services makes it inappropriate to rely on these two simple measures of physical output.¹⁴ Local service includes local exchange access, usage, and numerous vertical services. LEC Toll service includes message service, unidirectional service, and private line service. These toll services are further differentiated by numerous characteristics such as distance and time-of-day. Therefore, absent detailed physical measures for these various services, deflating revenues by price indexes that account for price changes in these various services produces a more accurate measure of

¹² All spreadsheet references are to the revised version of the AT&T model, developed by Dr. John R. Norsworthy, made available to interested parties on July 10, 1996.

¹³Norsworthy Report, p. 73.

¹⁴ Reply Comments, pp. 11-12.

actual output quantities. In our LEC TFP studies, we have used detailed information on LEC price changes to construct service category output price indexes, which are then used to deflate service category revenues to obtain output quantities.¹⁵ Because AT&T's physical measures represent a gross simplification of actual output, use of AT&T's physical measures for Local and Toll output results in an average overstatement in productivity growth of 0.9 percentage points over the 1988-1994 period, and 0.9 percentage points over the most recent five-year period, 1989-94.

Interstate Access Output. The revised version of the AT&T-sponsored spreadsheet analysis differs from the original AT&T spreadsheet model in the computation of Interstate Access Output. AT&T's revised index of Interstate Access Output (AT&T spreadsheet TFPLEC.WK4, T23-T33, and constructed in the AT&T spreadsheet YAGG.WK4, AI139-AI149) departs from the conventional approach to output measurement and has no apparent economic rationale. The correct way to measure Interstate Access Output is to construct price and quantity indexes for the services actually purchased by consumers and interexchange carriers. If one correctly computes the quantity indexes for Interstate Access services, one can obtain the price index by dividing actual revenue by the constructed quantity indexes.

For Interstate Access, end user customers pay a per line fee for access—i.e., the End User Common Line (EUCL) charge. Also, interexchange carriers and other

¹⁵ For a description of our methods, see Laurits R. Christensen, Philip E. Schoech, and Mark E. Meitzen, "Total Factor Productivity Methods for Local Exchange Carrier Price Cap Plans," Attachment A to Comments of United States Telephone Association on Fourth Further Notice of Proposed Rulemaking, CC Docket 94-1, January 16, 1996, pp. 3-9, and Appendix 2.

Interstate Access customers pay certain per minute fees for access services.¹⁶ Thus, because of the rate structure, the correct quantity index for End User Common Line ("EUCL") revenue is the number of access lines on which EUCL is charged. The correct quantity index for Carrier Switched Access, including the Carrier Common Line subcategory, is minutes of use.

The USTA TFPRP model is based on correctly measured quantities. The quantity index of End User Access is based on the number of switched access lines. The quantity index for Carrier Switched Access is based on the billing units for switched access: common line minutes of use and traffic sensitive minutes of use. In each case, the price index is equal to actual revenue divided by the proper quantity index.

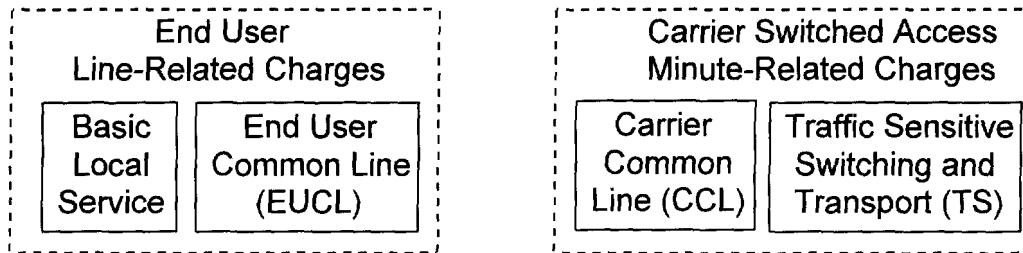
As described below, the AT&T model makes a fundamental error in confusing a service billed on a per-line basis to end users, End User Common Line, with a service billed primarily to interexchange carriers on a per-minute basis, Carrier Common Line. The end result of mixing and matching line-related and minute-related categories is that the AT&T model effectively eliminates the slowest growing interstate output category from its computations, thus upwardly biasing the measurement of total output growth and productivity growth.¹⁷ An overview of this fundamental error is found in Exhibit 2.

¹⁶ Per minute interstate access rates include those for: carrier common line (CCL) charges; local switching; transport; information; and the Transport Interconnection Charge (TIC).

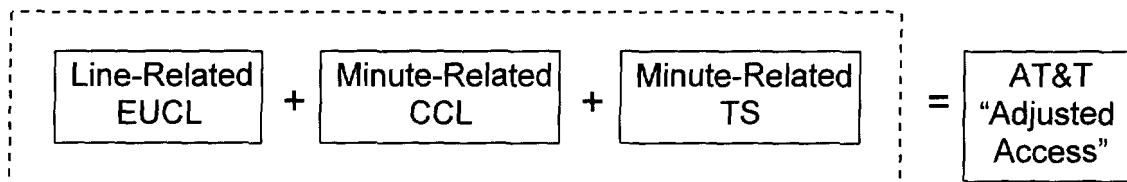
¹⁷ In the original AT&T model, the End User Access quantity index, based on number of total access lines, grew at an average annual rate of 2.6% over the 1988-1994 period. In the revised AT&T model, the End User Access quantity index, erroneously based on carriers common line minutes of use, grew at an average annual rate of 8.4% over the 1988-1994 period.

Exhibit 2
AT&T's Errors In Measuring Interstate Access Output

1. Actual Structure of End User and Carrier Switched Access Services



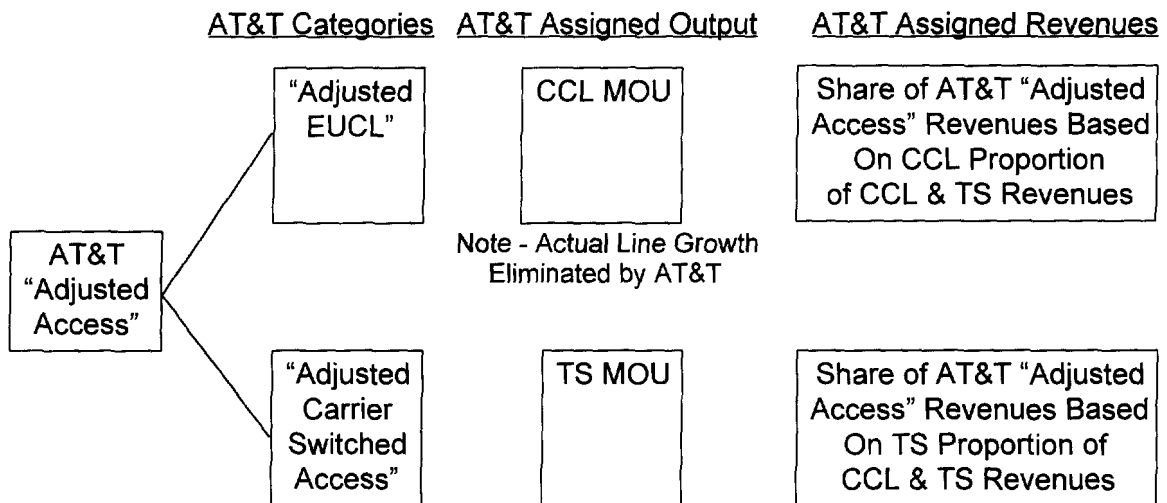
2. AT&T's Erroneous Switched Access Structure



AT&T incorrectly assumes that each of these revenue streams grows by minutes, ignoring the fact that EUCL revenues grow by lines.

Exhibit 2 (Cont.)
AT&T's Errors In Measuring Interstate Access Output

3. AT&T Segments Its "Adjusted Access" Category Into Sub-Categories
 "Adjusted EUCL" and "Adjusted Carrier Switched Access," and
 Assigns Output Growth and Revenues to These

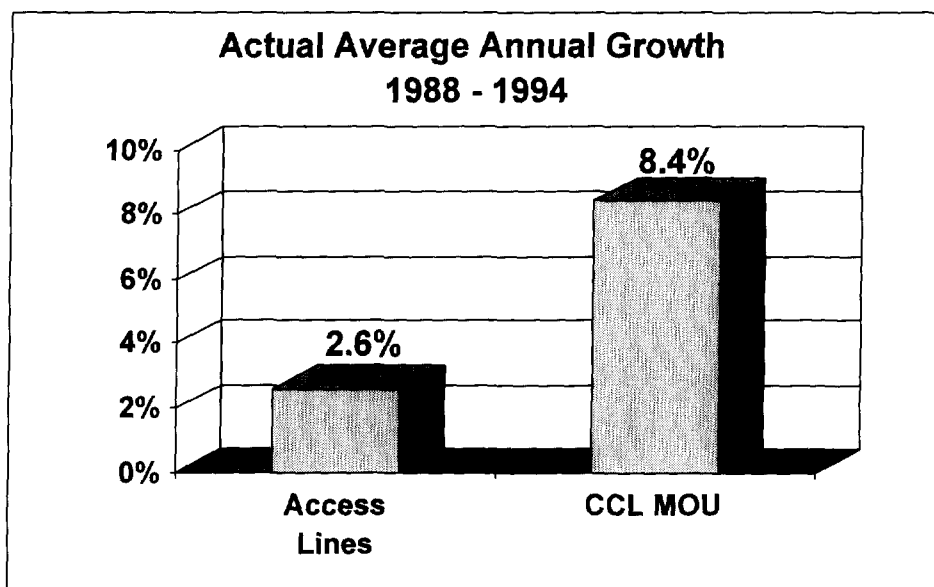


Output growth for both AT&T subcategories is based on minutes - line has been eliminated.

Exhibit 2 (Cont.)

AT&T's Errors In Measuring Interstate Access Output

4. In AT&T's calculation, the EUCL output category has been entirely eliminated. By assigning CCL MOU to its "Adjusted EUCL" category, AT&T has eliminated the slowest growing output category, EUCL output, which grows by access lines, from its computation of output growth. THE RESULT IS AT&T OVERSTATES PRODUCTIVITY.



The revised AT&T-sponsored model incorrectly calculates the quantity index for End User Access (found in AT&T spreadsheet YAGG.WK4, cells G139-G149, which, in turn are referenced back to cells DC139-DC149). Instead of basing the quantity of End User Access on the number of switched access lines, the AT&T model erroneously bases it on the number of carrier common line minutes of use billed primarily to the *interexchange carriers*.¹⁸ This is a fundamental flaw in the AT&T-sponsored model, because a LEC service billed to end users on a per-line basis is confused with a LEC service to carriers on a per-minute basis. Moreover, since EUCL is not billed on minutes of use, this error leads to a significant overstatement of the growth in the End User Access quantity index and an overstatement in total output and productivity growth.

In addition to erroneously using Carrier Common Line minutes of use to estimate the quantity of End User Access, the revised AT&T model incorrectly “adjusts” End User revenue and Carrier Switched Access revenue, leading to errors in their prices. This erroneous adjustment is, again, based on the fundamental mistake of confusing a LEC service to end users with a LEC service to carriers. The revised AT&T model assigns adjusted revenues to the End User Common Line and Carrier Switched Access categories based on the proportion of revenues in the Carrier Common Line and Traffic Sensitive subcategories of Carrier Switched Access revenue. The adjusted revenue for the End User

¹⁸ There are rare instances where switched access is purchased by end users. For example, some small businesses use Feature Group A switched access as a substitute for toll services, and Feature Group B switched access is used by businesses for credit card validation.

category is based on the proportion of *Carrier* Common Line revenues in the Carrier Switched Access category, and adjusted revenue for Carrier Switched Access is based on the proportion of revenue in the Traffic Sensitive subcategory of Carrier Switched Access. The following describes how these adjustments are made in the AT&T-sponsored model.

Adjusted End User Access revenue (AT&T spreadsheet YAGG: N139-N149) is obtained by adding actual End User Access revenue (AT&T spreadsheet YAGG: B139-B149) to Carrier Switched Access revenue (AT&T spreadsheet YAGG: C139-C149) then multiplying this total by the fraction of Carrier Switched Access revenue obtained from common line minute-of-use charges (AT&T spreadsheet YAGG: L139-L149, referenced back to CU139-CU149). The “adjusted” Carrier Switched Access revenue (AT&T spreadsheet YAGG: O139-O149) is the proportion of Carrier Switched Access revenue obtained from traffic sensitive minute-of-use charges (AT&T spreadsheet YAGG: M139-M149, referenced back to CV139-CV149). Thus, these adjusted shares do not represent the proportion of End User and Carrier Switched Access revenues—they simply represent the proportions of common line and traffic sensitive revenues in Carrier Switched Access revenues. Since adjusted revenue does not represent the amount actually paid for End User and Carrier Switched Access services, the resulting price indexes are not economically meaningful.

The erroneous measurement of Interstate Access output in the AT&T model results in an overstatement in productivity growth of 0.6 percentage points per year for the 1988-1994 period, and 0.5 percentage points per year for the most recent five-year period, 1989-1994. Moreover, the conceptual error of confusing EUCL with CCL indicates a fundamental lack of knowledge of the LEC industry.

The AT&T Model Incorrectly Measures Cost for Labor, Materials, and Capital

We discussed above the error made by AT&T in using Total Revenue as a proxy for Total Cost. Even if one were to accept this approach to measuring Total Cost, which one should not, the AT&T model still suffers from significant errors in assigning Total Cost to Labor, Capital, and Materials. These errors appear to arise from a misuse of the ARMIS accounting reports.

One can correctly measure Labor and Materials expense directly from the ARMIS Report No. 43-02 Operating Expense statement. Total Operating Expense can meaningfully be subdivided into three major components: the amount of Wages, Salaries, and Benefits (Labor Cost) booked to Operating Expense; the amount of Depreciation and Amortization Expense booked to Operating Expense; and the amount of Other Expenses (Materials Cost) booked to Operating Expense. Of these three components, two—Labor and Depreciation/Amortization are directly reported in the ARMIS Operating